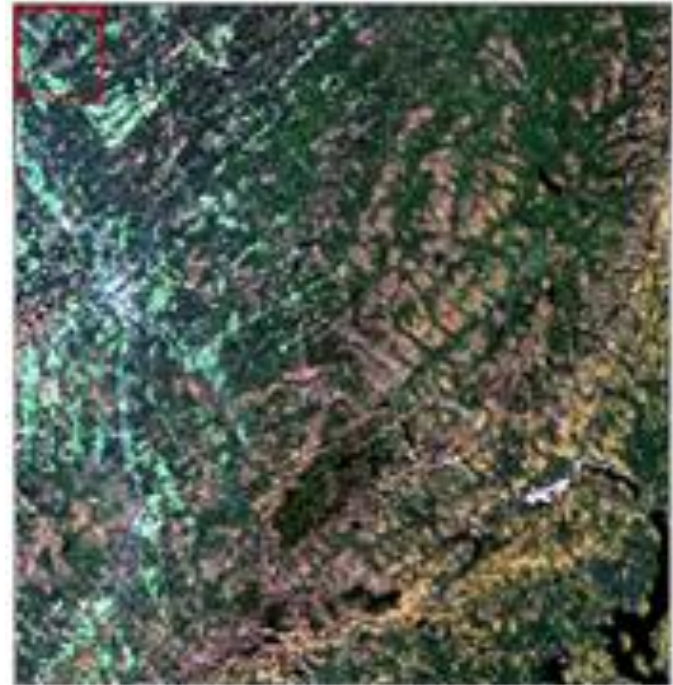


Analysis of Landsat 8 OLI, Landsat 7 ETM+, OLI Required, ETM+ Simulated and OLI Compressed using Variograms

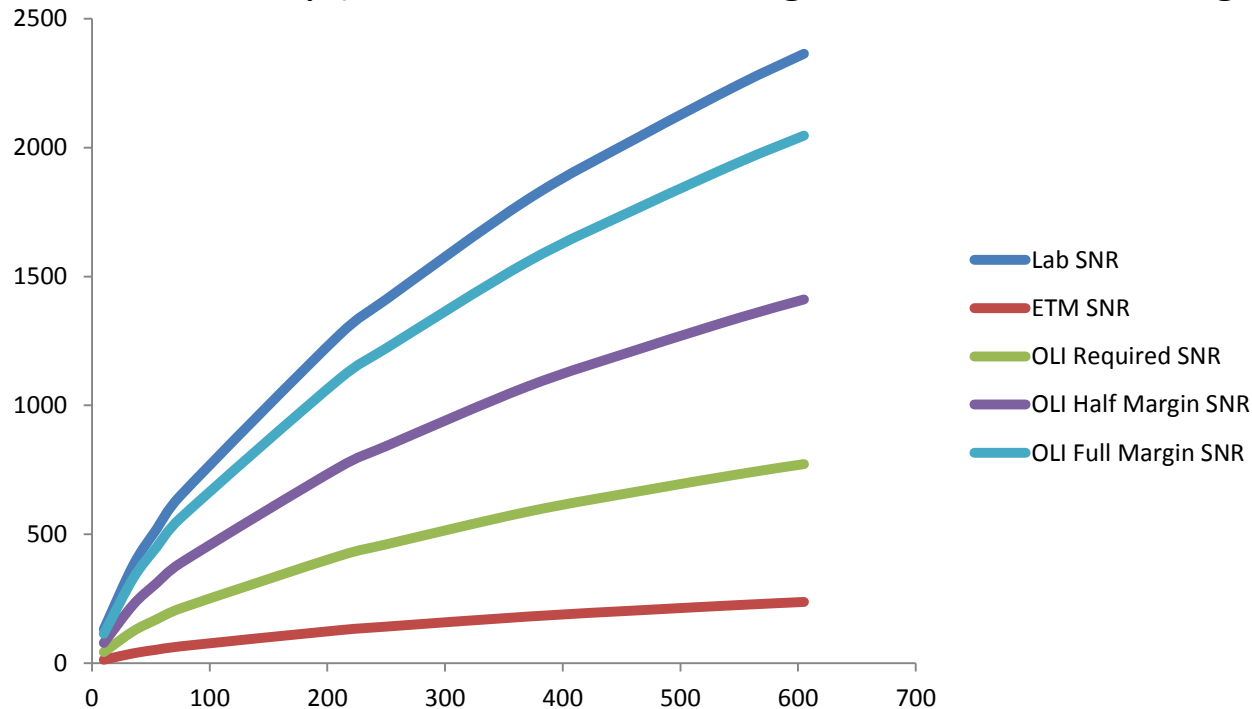
Curtis Woodcock, Boston University

1. Data: p12 r28
2. Location: Rockwood, ME
3. Size: 3000 X 3000 pixels
4. Sample size: 5%
5. 0% cloud coverage
6. Bands used
 - Green
 - Red
 - NIR



Methodology

- The assumption that lab-measured SNR is being achieved on orbit was made. The dark blue curve below shows lab-measured SNR vs illumination for Band 2 of OLI.
- Landsat requirements documents indicate “required SNR” at typical on-orbit radiance levels (L_{typ}) for each band of ETM+ and OLI.
- The ratio of the required SNR for ETM+ and OLI at L_{typ} (see **x**’s in figure below) are calculated and applied across all signal levels...this is performed for each band.
- Two additional noise levels based on preliminary lab measurements of OLI’s SNR were included in this study (Labeled “OLI Half-Margin” and “OLI Full-Margin” SNR).



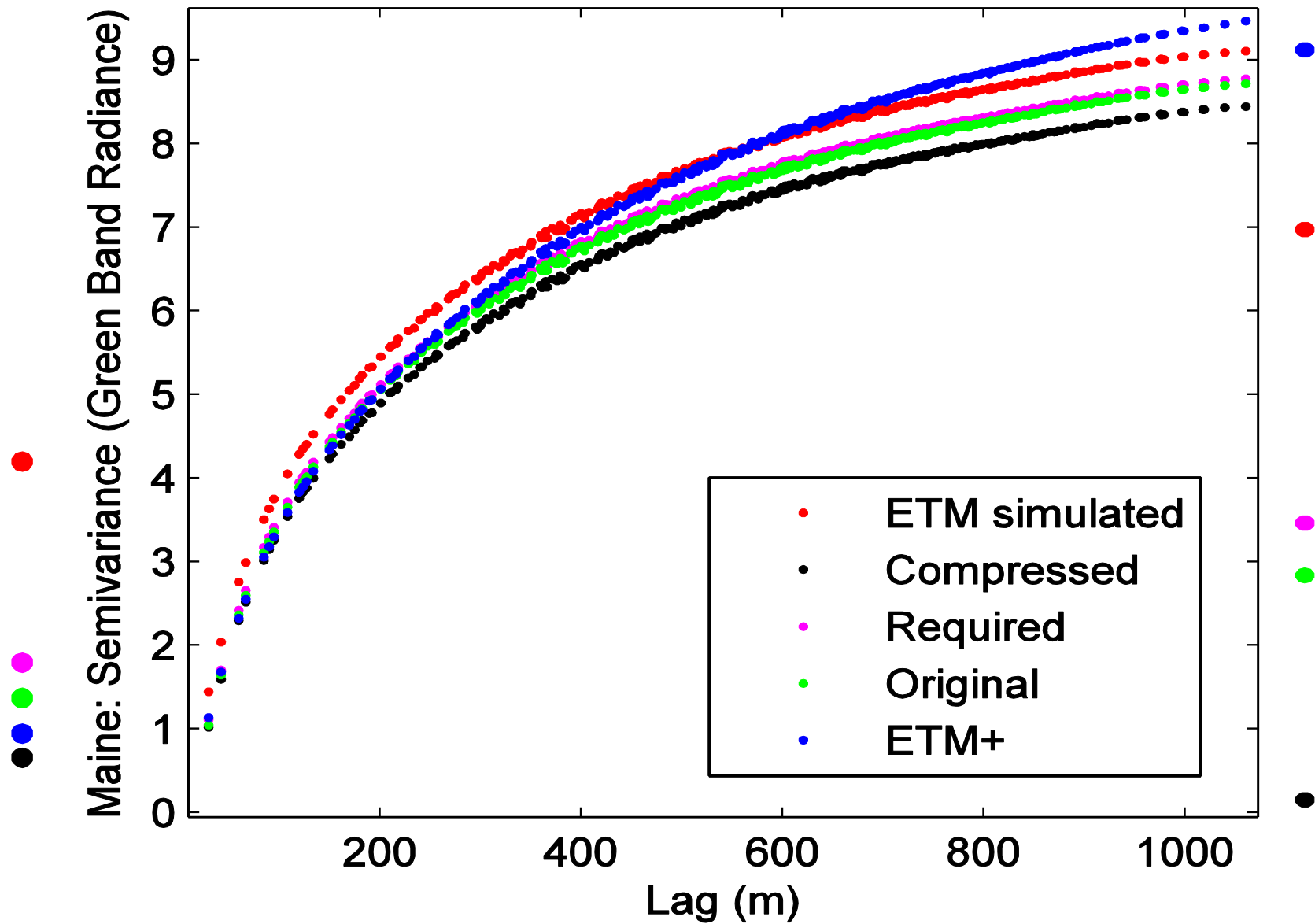
Variograms

- Basically measure variance as a function of distance (average squared difference between observations as a function of distance)
- The sill is the height of the variogram at distances beyond any structure (or correlation in the image) and equals the variance of the image

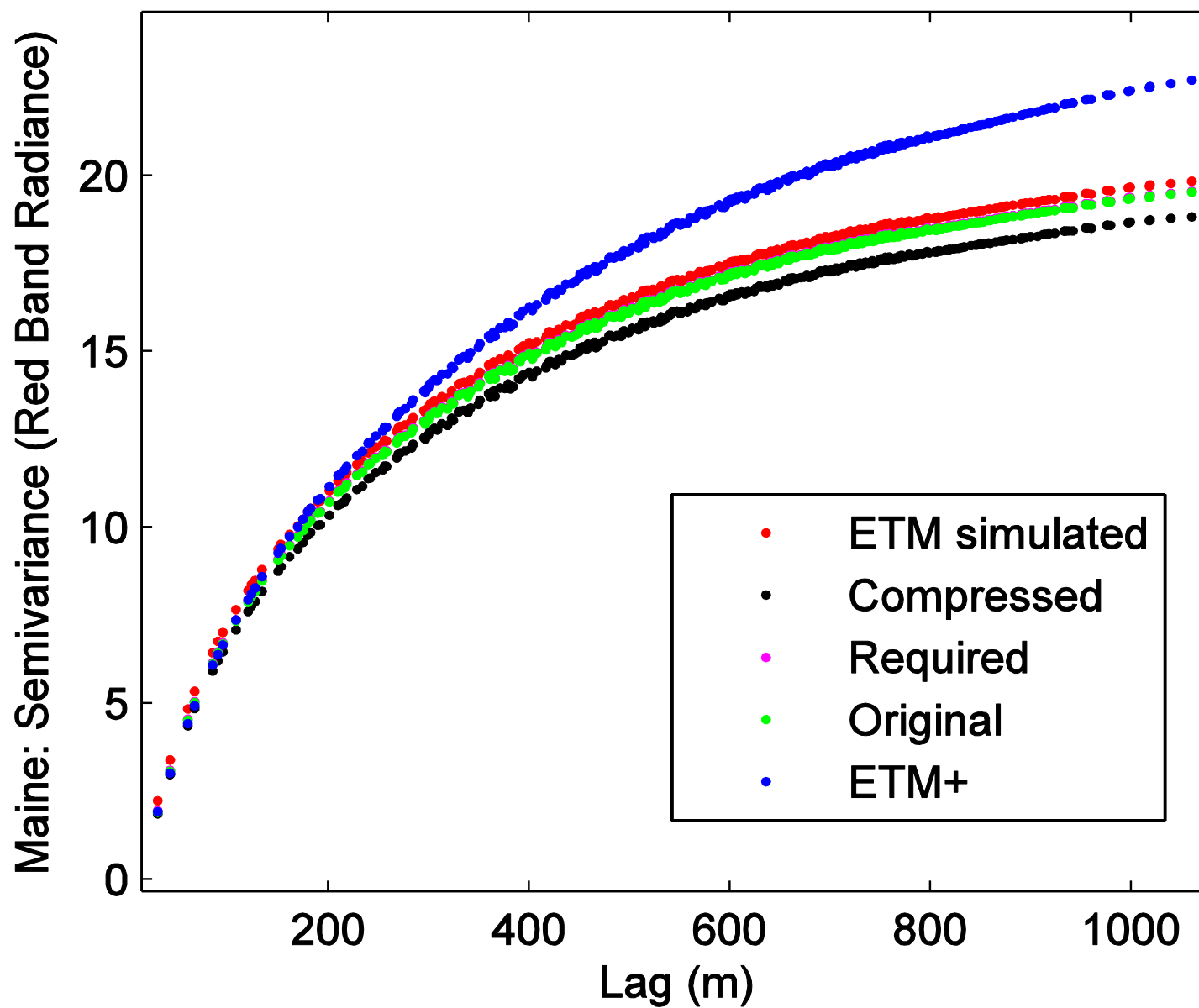
Factors affecting variograms

- Noise increases the height of the variogram
- Smoothing (high pass filter, for example) lowers the variogram
- Coarser spatial resolution lowers the variogram

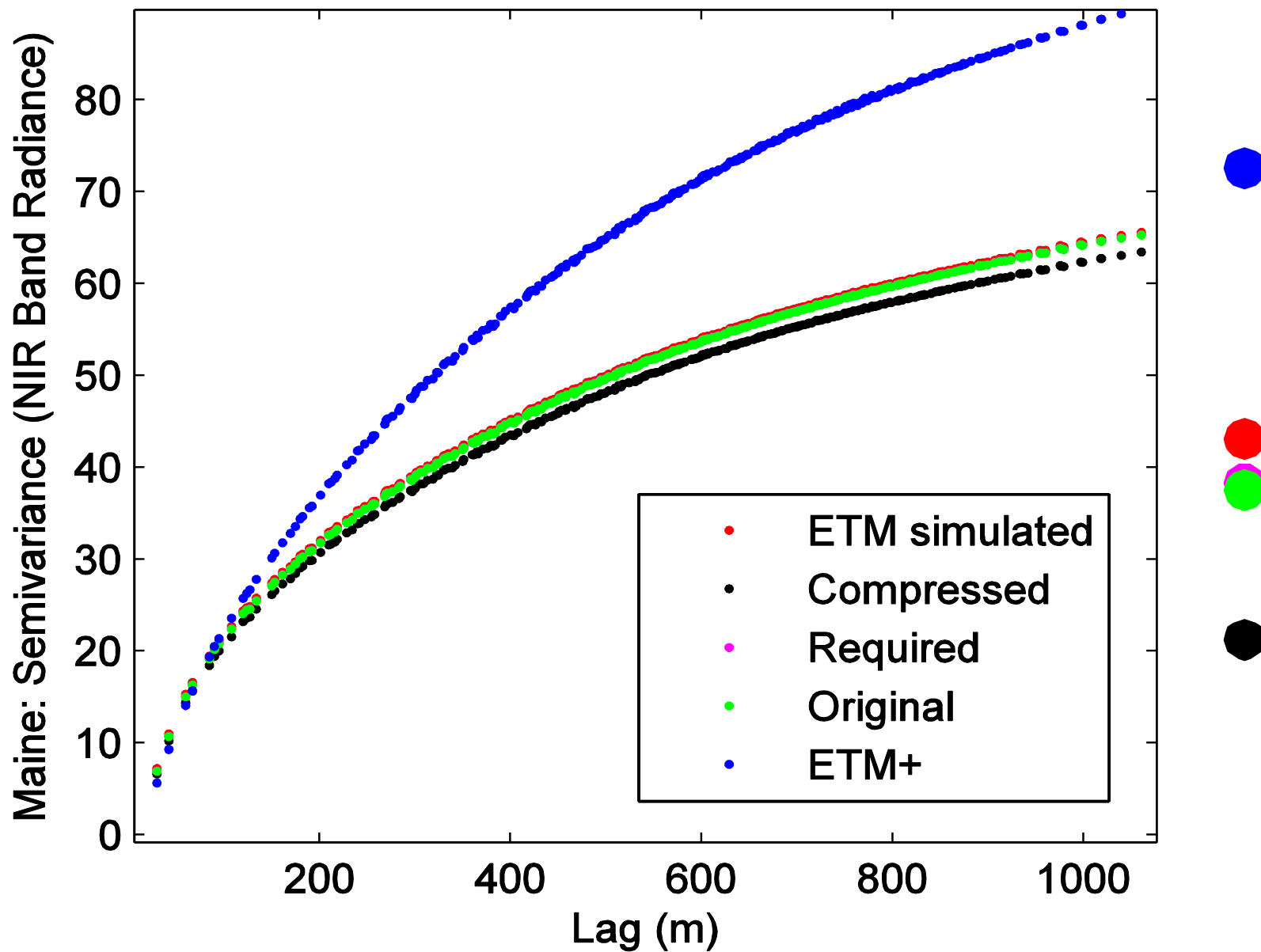
Green Band



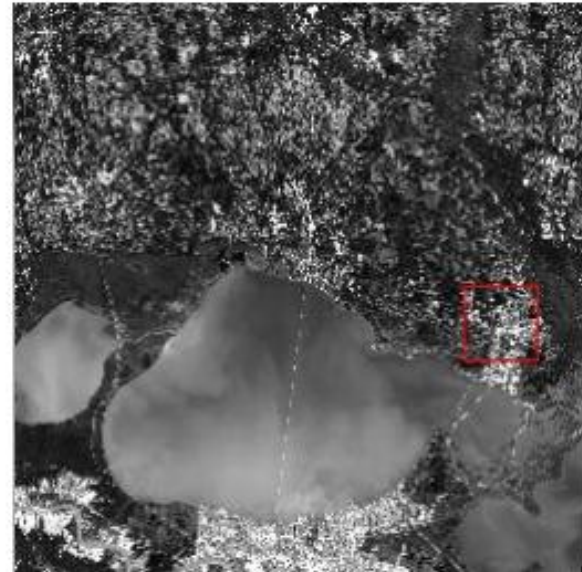
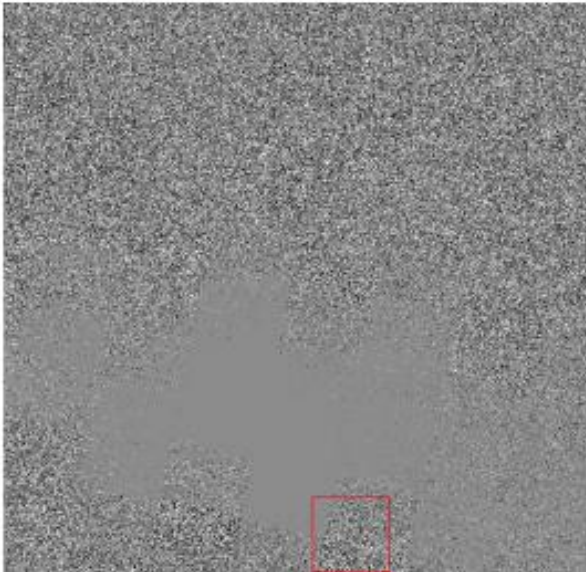
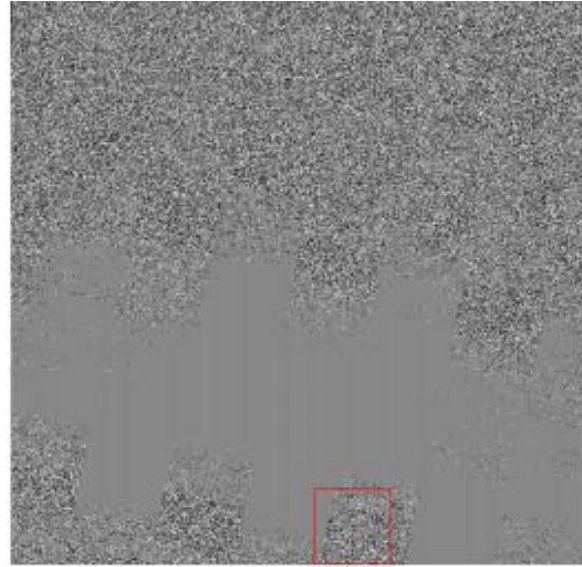
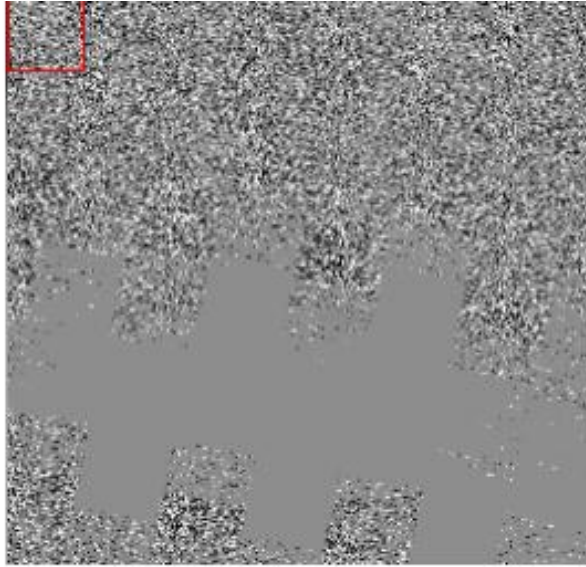
Red Band

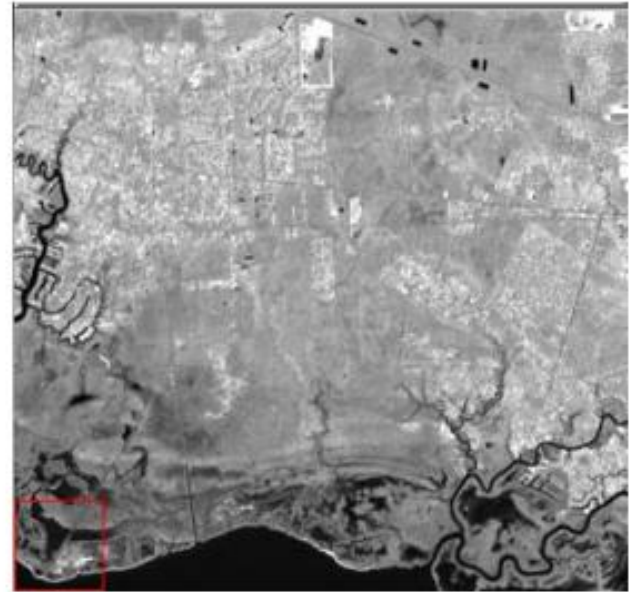
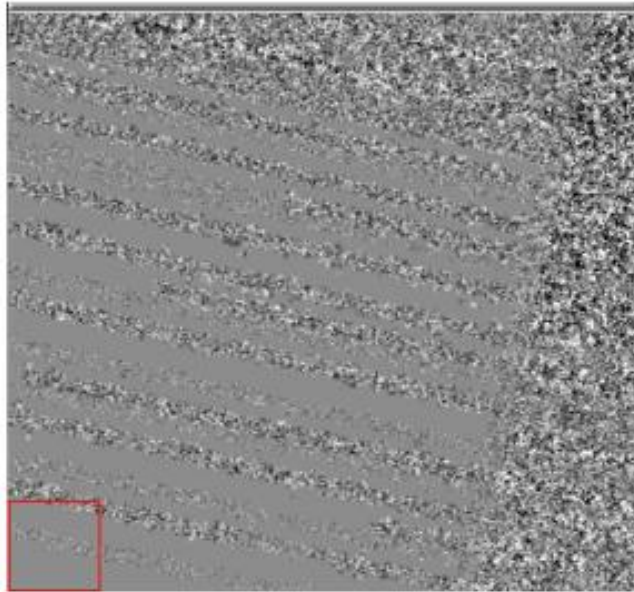
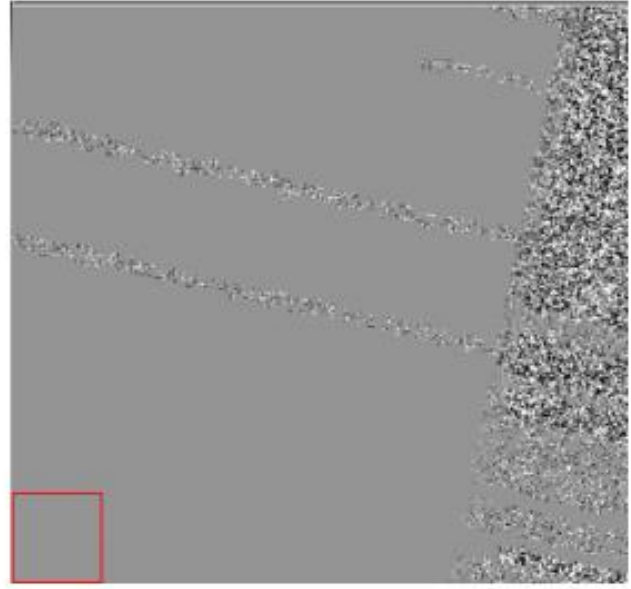
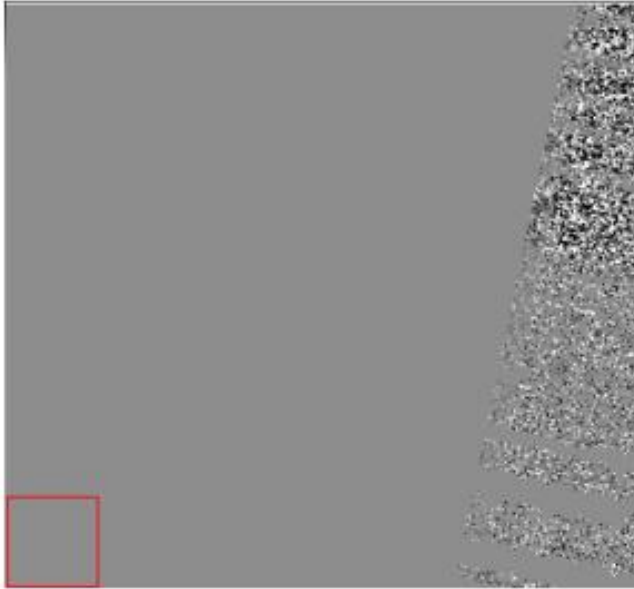


NIR Band



Differences between OLI Original and OLI Compressed of Green, Red, and NIR Bands (DN)





original DN – compressed DN == 0 (Landsat 7 ETM+ scale)

	New Orleans	Boston	Rockwood
Green Band	49.19%	11.83%	99.41%
Red Band	41.60%	7.11%	89.92%
NIR Band	21.02%	2.44%	2.57%

original DN – compressed DN == (-0.5, 0.5) (Landsat 7 ETM+ scale)

	New Orleans	Boston	Rockwood
Green Band	99.43%	98.05%	99.99%
Red Band	96.91%	89.35%	99.99%
NIR Band	98.89%	95.41%	99.39%

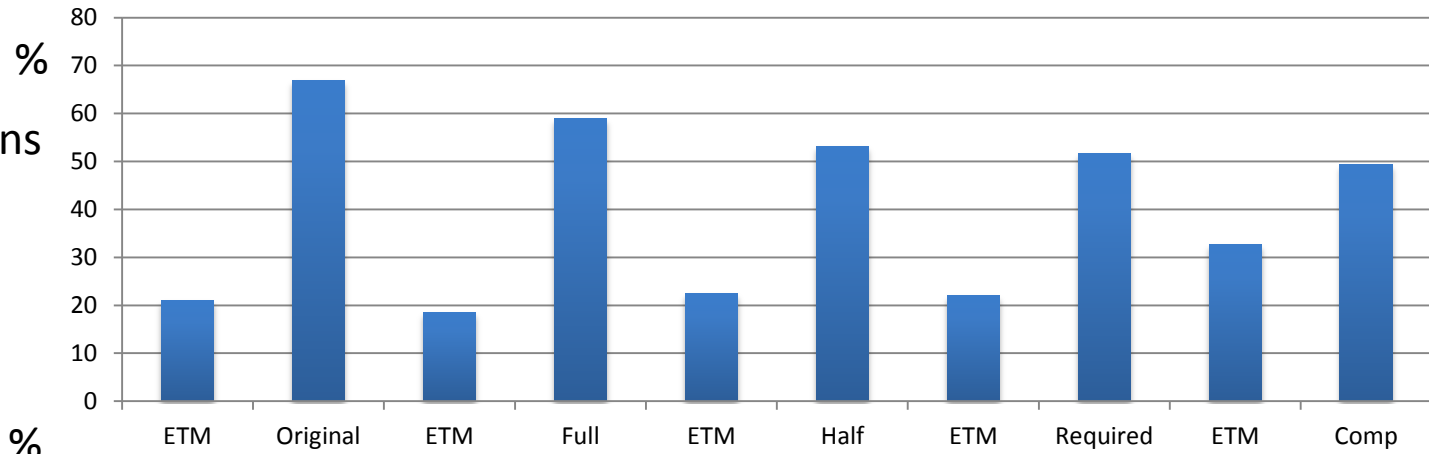
Random Forest classification of Landsat 8 OLI Original, OLI Full, OLI Half, OLI Required, OLI Compressed, and ETM+ Simulated



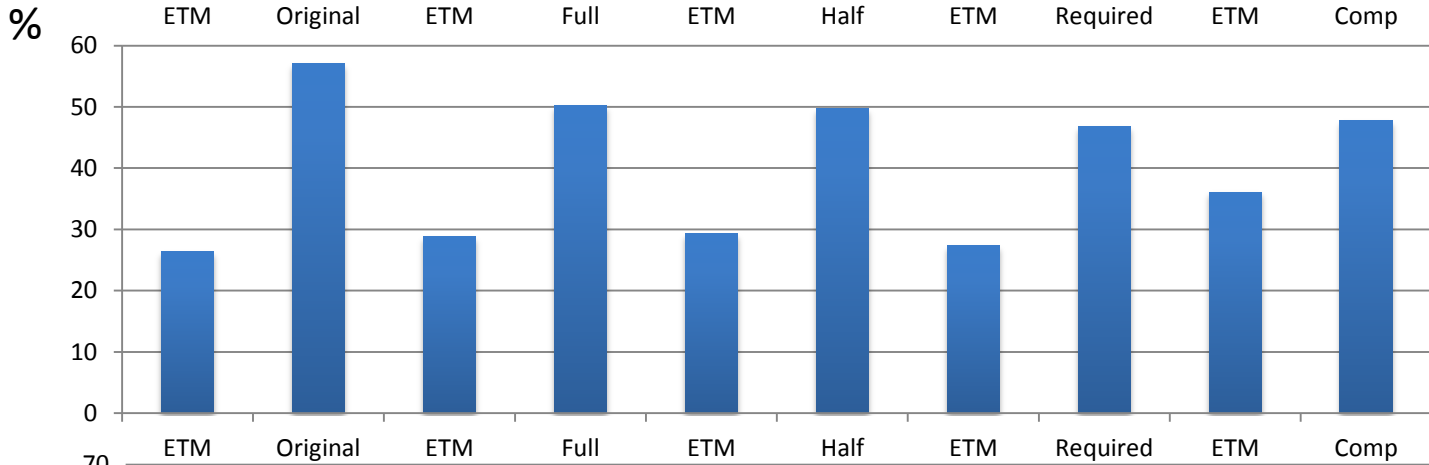
- New Orleans, LA (p22 r39)
- Boston, MA (p12 r31)
- Rockwood, ME (p12 r28)

Accuracy Assessment on classification results that do not agree

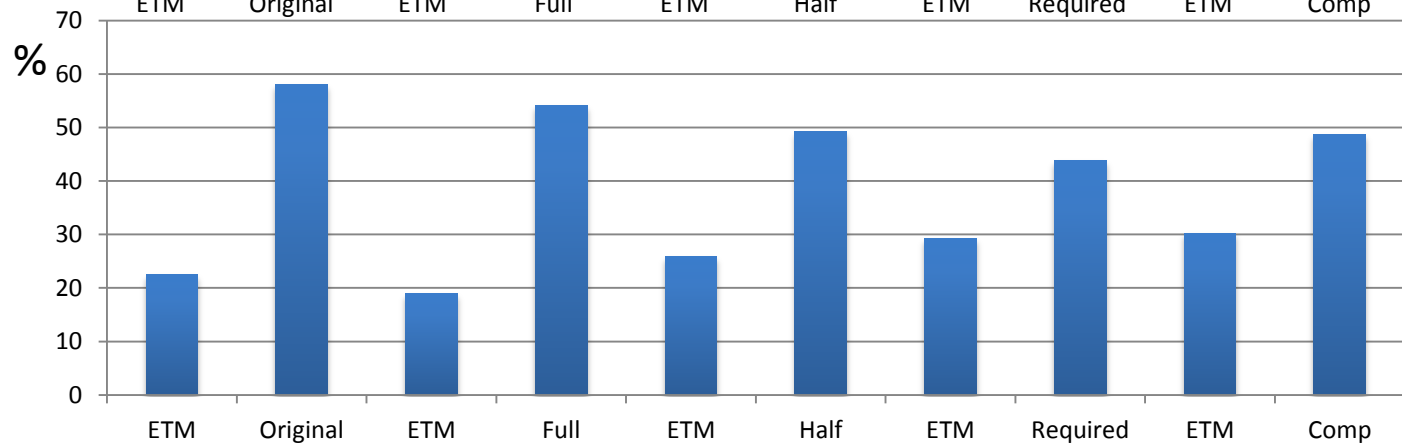
New Orleans



Boston



Rockwood



Concluding thoughts

- Variograms of the original OLI image, and all the derivatives make sense -- as SNR decreases the sill of the variograms rises and compression reduces overall signal (and semivariance)
- Comparisons with ETM+ images is trickier as it may include effects related to changes in effective field of view (needs some more work and thought)
- Image classification is improved using OLI data compared to ETM+ (or, everything we do with OLI is going to work better than with prior Landsat sensors!!!)
- Compression reduces effective SNR, less than the shift to OLI requirements level (maybe closest to the “half” level) (based on classification results)